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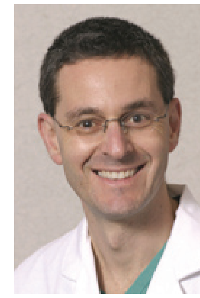
Long-term Mechanical Support for Complex Left Ventricular Postinfarct Pseudoaneurysms



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ABSTRACT

Left ventricular free wall rupture can be a catastrophic problem. Although small lacerations can be managed with various techniques of primary closure, larger and more complex defects can be difficult to treat. We present and discuss 2 cases of chronic, complex ventricular pseudoaneurysms managed successfully with long-term mechanical support.

INTRODUCTION

Left ventricular free wall rupture (LVFWR) is a typically fatal complication that can occur in 4% to 8% of all acute myocardial infarctions, particularly those involving >20% of the ventricle [Pohjola-Sintonen 1989]. Simple or small ruptures have a favorable prognosis; however, repair of complex ruptures or chronic pseudoaneurysms have a worse prognosis, owing to postoperative bleeding, arrhythmias, recurrent aneurysms, and heart failure [Frances 1998]. Increased ventricular pressures can also cause catastrophic postoperative bleeding from a friable myocardium. We present 2 cases and discuss the use of long-term mechanical support in patients with complex postinfarction ventricular pseudoaneurysms.

CASE 1

A 43-year-old man initially presented in cardiogenic shock secondary to a ruptured anterolateral papillary muscle, acute mitral regurgitation, and severe left ventricular dysfunction from a recent lateral wall myocardial infarction. He underwent emergent mitral valve replacement (mechanical mitral valve, size 29; St. Jude Medical, St. Paul, MN, USA). At that time, a presumed lateral wall aneurysm was encountered. Initially, the aneurysm was not treated because the lateral wall was densely adherent to the pericardium. The patient was weaned from cardiopulmonary bypass with minimal inotropic support, and his initial postoperative course was unremarkable. He was discharged on postoperative day 9. On postoperative day 20, however, the patient was readmitted with worsening heart failure. Upon undergoing catheterization, his mixed venous PaO_2 was 28 mm Hg. An echocardiography evaluation revealed a normally functioning mitral prosthesis with a large lateral wall defect that filled a large cavity. Cardiac magnetic resonance imaging (MRI) revealed a large pseudoaneurysm with a neck length of 8.6 cm and an estimated volume of 58 cm^3 (Figure 1). There was a near-transmural infarct extending from the base to the apex and involving the residual inferior, inferolateral, and anterolateral segments (Figure 2). The ejection fraction could not be estimated because of the size of the defect. The patient was taken urgently to the operating room, where the pseudoaneurysm was resected. The tissue was noticed to still be quite friable, but because of the minimal residual functioning myocardium, a pulsatile HeartMate XVE left ventricular assist device (LVAD) (Thoratec, Pleasanton, CA, USA) was implanted immediately. This device was chosen because it was unclear whether the patient would be

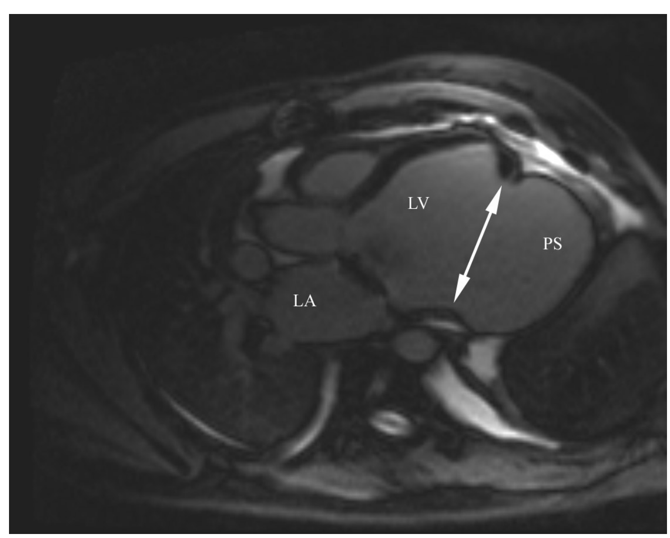

Figure 1. Cardiac magnetic resonance imaging of large, contained pseudoaneurysm of the left ventricular (LV) cavity with extensive destruction of the lateral wall. Arrows indicate neck. LA indicates left atrium; PS, pseudoaneurysm.

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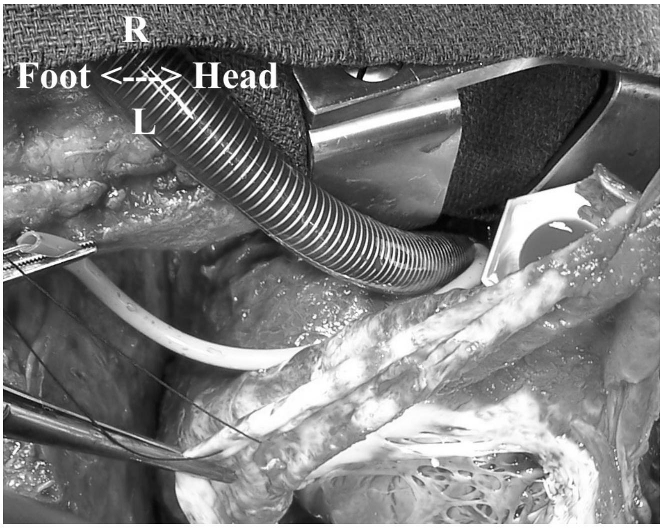

Figure 2. Intraoperative picture demonstrating the extent of a pseudoaneurysm compared with the remaining ventricular cavity. The prosthetic mitral valve is visible through the opening.

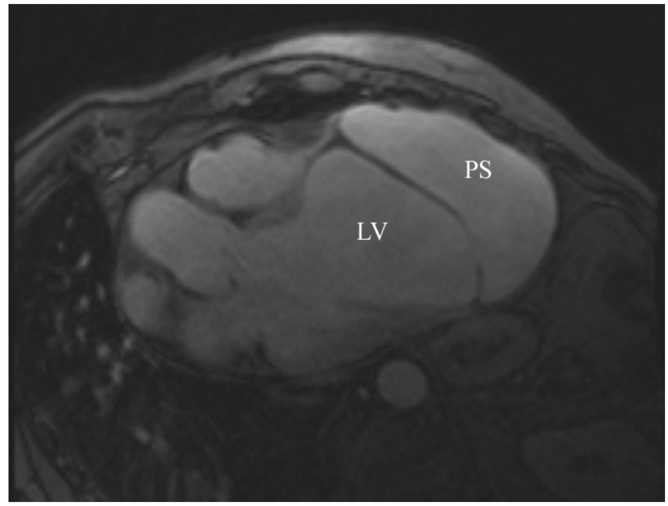

Figure 3. Magnetic resonance imaging of the left ventricular (LV) cavity with the pseudoaneurysm (PS) arising from a small communication and a thin membrane between the 2 cavities.

an appropriate candidate for heart transplantation. Postoperatively, he had intermittent low VAD output, which was presumed to be secondary to the small residual ventricular cavity or to a poor cannula alignment due to distortion of the ventricular cavity with respect to the outflow cannula and the mitral valve. The VAD output did not improve despite several attempts at cannula repositioning. On postoperative day 22 (after implantation of the LVAD), the patient underwent uncomplicated heart transplantation. He is doing well at 1 year after transplantation.

CASE 2

The second patient is a 51-year-old man who presented with severe congestive heart failure and an ejection fraction of 10% to 15% secondary to a chronic occlusion of the left anterior descending coronary artery. An echocardiography examination revealed anterior akinesis, pulmonary hypertension, moderate aortic insufficiency, and moderate to severe mitral regurgitation. He had no other major medical problems, but he did admit to long-standing alcohol and tobacco abuse. A cardiac MRI examination to evaluate myocardial viability revealed a large-necked lateral wall defect consistent with a ventricular pseudoaneurysm. Intraoperatively, the defect was found to extend from the apex to the outflow tract with residual chronic dissection of the surrounding epicardium and endocardium (Figure 3). Because concomitant aortic and mitral valve surgery with either primary closure or patch reconstruction of the defect were not felt to be capable of restoring sufficient ventricular function for long-term survival, a long-term VAD was placed. The aortic valve was sewn shut, and the ventricular defect was resected and closed linearly. A VentrAssist continuous-flow LVAD (Ventracor, Chatswood, New South Wales, Australia) was implanted with conventional techniques as a planned bridge to transplantation. Postoperatively, the patient required reexploration for tamponade. The ventricular closure line and VAD cannulation sites were hemostatic. A diffuse ooze was encountered and was presumed to be secondary to the preoperative use of antiplatelet and anticoagulation agents. The remainder of the patient's postoperative course was unremarkable, and he was discharged on day 22. At 6 months after the operation, the patient was in class I heart failure. At 9 months postoperatively, he had abstained from smoking and drinking and was currently undergoing evaluation for cardiac transplantation.

DISCUSSION

Acute LVFWR with small tears can often be repaired with a patch-and-glue technique with acceptable results, whereas large "blowouts" are often catastrophic [Mantovani 2002]. Patients with chronic pseudoaneurysms from contained ruptures can present with refractory heart failure secondary to the extent of ventricular infarction and/or mitral regurgitation; hence, their management can be more complex. Surgery is aimed toward preventing unpredictable death and preserving ventricular function and geometry. Primary repair is advocated for smaller defects, and larger defects may require patch reconstruction [Atik 2007]. Nevertheless, fatal bleeding and heart failure are common. In-hospital mortality rates range between 15% and 60%, depending on the complexity of the repair and the need for concomitant treatment of associated cardiac pathology [Sakaguchi 2008]. Respiratory, renal, septic, and bleeding complications are also common. For the few patients who survive their initial presentation and surgical treatment, 1-year and 5-year survival rates are 60% to 80% and <60%, respectively, with most deaths being cardiac [Canovas 2003; Atik 2007]. Unpublished complication rates are probably much higher, because the experience with LVFWR tends to be limited.

The use of long-term mechanical-assist devices for refractory end-stage heart failure is becoming more successful, either as destination therapy or as a bridge to transplantation [Kirklin 2008]. As results improve, their indications can be expanded further. The current series of mechanical-support devices for complications of LVFWR illustrates an application in patients with extremely complex cardiac problems, for which primary repair, even if possible, is associated with extremely high morbidity and/or mortality and a poor long-term prognosis. In both of our patients, LVADs were used to support long-term ventricular function in cases of extensive myocardial infarctions with limited residual viable myocardium—a strategy similar to the application of early mechanical support in patients who present in cardiogenic shock after acute myocardial infarction [Tayara 2006]. Furthermore, the risk of early postoperative fatal hemorrhage is reduced by unloading the ventricle and essentially turning it into a passive low-pressure conduit. One potential drawback is that these patients may end up with small ventricular cavities secondary to the small amount of residual viable myocardium and to the closure technique. Such small cavities may make positioning of the inflow cannula difficult or cause inadequate filling of pulsatile pumps. More widely available access to continuous-flow pumps, as in our second case, may minimize these problems. The left atrium may be considered as an alternative cannulation site, although positioning and thrombus formation challenge this approach, particularly in patients with relatively small left atriums that have not become enlarged from long-standing disease. Alternatively, use of a totally artificial heart might address the potential cannulation challenges, but this pathway mandates transplantation and precludes hospital discharge.

We have previously described the use of long-term biventricular support for other complex complications of acute myocardial infarction [Sai-Sudhakar 2006]. These reports describe the use of this approach with left ventricular pseudoaneurysms, further adding to the armamentarium of techniques used to treat this uncommon, challenging, and high-risk clinical problem. Although our experience has involved the use of long-term support devices, it would not be unreasonable to use short-term and less expensive pumps as a temporary modality until choices of optimal devices can be based on patient end-organ viability or transplantability. Short-term pumps that are easy to implant may also facilitate transfer of patients to an experienced VAD/transplantation center for long-term mechanical support or transplantation, which may be the only option for those with unsalvageable hearts.

CONCLUSIONS

LVFWRs remain a formidable problem. Small tears may be successfully treated with a variety of techniques, but more complex and larger defects are associated with increased short-term and long-term complications. Our initial experience with mechanical support in patients with complex pseudoaneurysms suggests that this approach can be a valuable tool in this high-risk population. Continuous-flow pumps may be preferable in patients with smaller ventricular cavities.

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